THE DENTAL PRACTITIONER

and

DENTAL RECORD

Including the official reports of the British Society of Periodontology, the British Society for the Study of Orthodontics, the European Orthodontic Society, the Liverpool and District Odontological Society, the North Staffordshire Society of Dental Surgeons, the Odonto-chirurgical Society of Scotland, and the Dental and Medical Society for the Study of Hypnosis

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CONTENTS

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THE DENTAL PRACTITIONER
AND DENTAL RECORD

Vol. VI, No. 3 November, 1955

EDITORIAL

CONTROL OF MATERIALS

THE science of dental materials has developed into an important aspect of modern dentistry. This specialized subject is being taught in a number of dental schools in its broadest field and is related to the clinical aspects of prosthetic and restorative dentistry, an undoubted improvement on the old course in dental metallurgy. A study of the basic properties of our daily materials becomes essential if we are to understand the manipulation of the many and varied substances and to avoid the pitfalls and failures that arise owing to a lack of knowledge. Research into such materials as amalgam and silicate covering a great number of years has improved our treatment beyond belief, while all the new impression materials owe their usefulness to scientific research. The list is long and the work that has gone into them little known or appreciated. The men who perform this service to dentistry are the many chemists and physicists who work behind the scenes in the great industrial houses, a small handful of enthusiasts in dental schools and private practice in various parts of the world, together with that hard working body in Washington—the National Bureau of Standards. The problems they have solved are numerous, such as the delayed expansion of amalgam, the expansions and contractions involved in gold casting, and the stresses and strains of acrylic denture bases, to name a few. Many of the failures of treatment can be traced to mishandling of materials and it is important that the findings of scientific bodies are known and techniques carried out in the correct manner. Each and every material we use has a specific controlled technique and it is all too easy to modify it to a simpler but deleterious form. A case in point is that of inlay casting wax, where failure to appreciate the known properties may cause failure in the final gold inlay. It is just as important to control the softening temperature of this material as it is to control the fusing temperature of a porcelain jacket crown. It is no more difficult to use a controlled technique for any one material than to use a slap-happy mishandling. The results are all too obvious in the mouths of our patients.

MINISTRY OF HEALTH PRIVATE SECRETARIES

The Minister of Health, the Rt. Hon. Iain Macleod, M.P., has appointed Mr. P. Benner to be his Private Secretary.

The Parliamentary Secretary to the Ministry, Miss M. P. Hornsby-Smith, M.P., has appointed Mr. J. P. Cashman to be her Private Secretary.

MATRICES FOR DECIDUOUS TEETH

By **GRACE BROWN**, F.D.S.
Department of Dentistry for Children, London Hospital Dental School

SILVER amalgam is a highly satisfactory filling material which is practical and efficient in the majority of cavities in the primary dentition. In all compound cavities a matrix is required to obtain proper condensation and marginal adaptation of the alloy. Lack of a matrix will result in overhanging margins, with consequent damage to the gingival tissue.

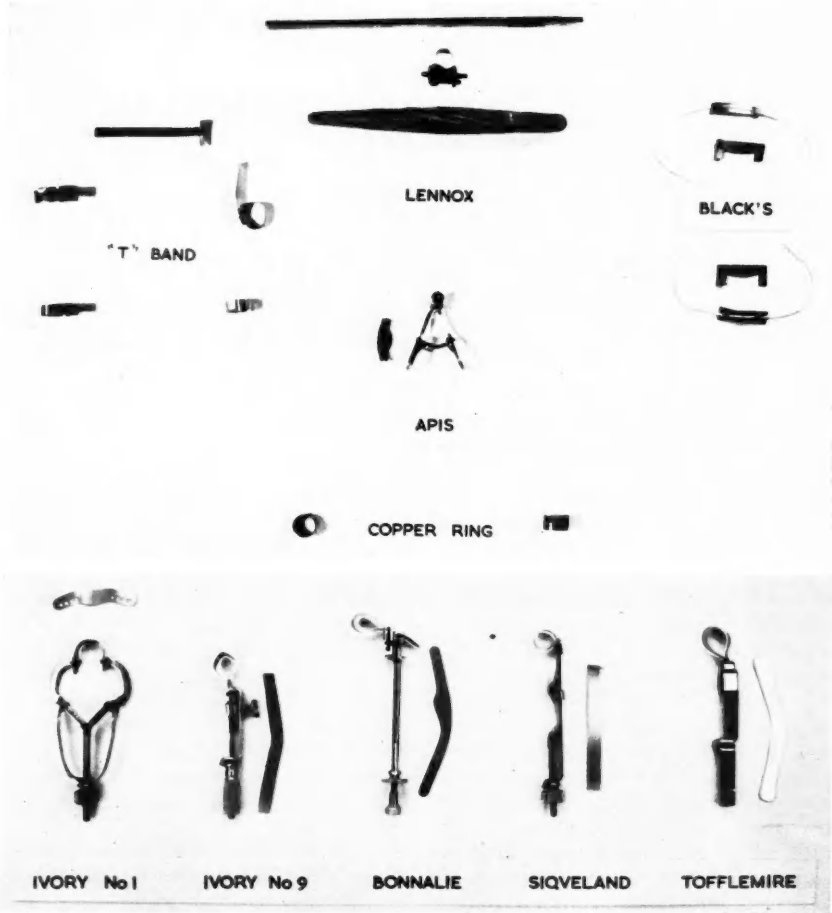

Fig. 1.—Types of matrix retainers and matrices.

Many types of matrix retainers are popular with the profession (*Fig.* 1). The Ivory No. 1 and No. 8, the Siqveland, and the

Bonallie are efficient when placed on the teeth of the permanent dentition. Children do not tolerate these well because of their size. The movements of the child's tongue, the lips, or

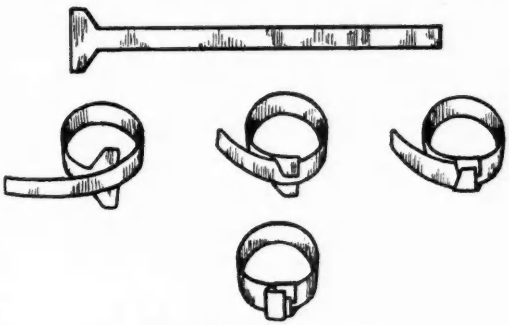

Fig. 2.—Formation of the T band.

even the weight of the matrix retainer, may dislodge the band from the primary molars as the teeth are short and bell-shaped. The Ivory No. 9 and the Tofflemire are smaller and more satisfactory.

A simple and successful matrix for the deciduous teeth is the T band. These bands can be obtained commercially under the name of Dr. Levett's matrices, but unfortunately they are rather expensive. However, until some enterprising dental firm produces a cheaper product such as can be obtained in the United States of America, the band may easily be made in the surgery from german silver or copper matrix band material. A pattern of the band is shown in the diagram (*Fig.* 2). A circle is made and the cross-pieces are bent over. The circumference of the circle is reduced to approximately that of the tooth, the band is placed around the tooth and adjusted as required. It is then removed. The upright is turned back and the excess is cut away.

After replacing the matrix on the tooth a small wooden or plastic wedge is introduced into the interproximal space (*Fig.* 3). A coating of warm green compound will aid its retention. The wedge forces the band material against the edges of the cavity, and excess amalgam is avoided. Owing to the divergence of the embrasures the wedge is placed lingually or palatally. When condensation of the amalgam is completed the wedge is removed and the occlusal surface is trimmed. The occlusion should be checked while the band is still in position. The cross-pieces are opened with a plastic instrument and the band is withdrawn laterally instead of vertically in order to retain the marginal ridge.

Fig. 3.—The T band in position with a wedge.

When an amalgam filling is to be inserted into a large compound cavity it may be desirable to leave the matrix band in place until a subsequent appointment to preclude the possibility of fracture of the filling before it sets. A seamless copper band, such as is used for copper ring impressions, is ideal for this purpose. A band of the correct size is selected, cut to the proper depth, annealed, and burnished tightly about the tooth. Care should be taken to see that the band fits over onto the occlusal surface to prevent movement towards the apices of the tooth and subsequent pain. The bite is checked, the contact point adjusted, and a wedge inserted. After condensation of the amalgam the occlusal portion is carved and smoothed and the patient is dismissed with the band in place. At the next visit the band is easily removed by cutting buccally or lingually with a fissure bur, and the restoration is finished with disks, polishing burs, and pumice.

Acknowledgements.—My thanks are due to Mr. A. M. Horsnell, Director of Conservative Dentistry, for permission to publish this article. I also wish to thank Mr. J. Morgan, of the Photographic Department, The London Hospital, for the preparation of the photographs, and Miss P. Archer, Medical Artist to The London Hospital Medical College, for the production of the diagrams.

A CONSIDERATION OF THE PHYSIOLOGICAL BACKGROUND OF MANDIBULAR POSTURE AND MOVEMENT*

By **C. F. BALLARD**, F.D.S. R.C.S., M.R.C.S., L.R.C.P., D. Orth. R.C.S.
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In the past many erroneous theories and deductions have been built up around the study of orthodontics; theories formulated with a lack of understanding of the evolutionary relationship between form and function in particular. This paper will endeavour to stress the evolutionary background of function, and the significance of this in explaining clinical findings.

Rogers (1950) myofunctional therapy could not be generally accepted because it did not work for reasons which will be apparent later. The Angle philosophy, although accepted by a large number of people, was based on the concept that the function of normal occlusion will stimulate the skeletal structures to grow, and the theory of functional therapy evolved round the Andresen or Monobloc appliance is based on the concept that function can be changed and that there will be a resultant change in the form of the jaws, the mandible in particular.

Most of these theories have been disproved by subsequent clinical analysis of a large number of cases, but many still remain to cloud the issue and hinder the transition of orthodontics from an art to a science.

In 1947 Gwynne-Evans and Ballard, realizing that the exercising of muscle patterns as in the myofunctional methods was not a physiological approach to the problem, conceived the idea of "re-educating" tongue and lip behaviour reflexly by the Andresen appliance. This again has failed for reasons now obvious.

The scientific assessment by Brash (1929) and the results of such investigations as that by Brodie, Downs, Goldstein, and Myer (1938) stimulated some of us to a more critical analysis of the whole aetiological background of malocclusion and its relation to treatment.

Brash said: "It appears that at the back of all this discussion about the lack of use of the jaws is the erroneous assumption that growth and size of bones must be in some direct ratio to the magnitude of the forces applied to them and the frequency of that application; whereas it is more than probable that there is a very wide range of activity within which growth will proceed in a perfectly normal manner, and that it requires an altogether exceptional degree of lack of use, amounting almost to cessation of use, to affect in any degree the growth of the bones concerned. No amount of exercise, on the other hand, can possibly induce any part of the skeleton to grow beyond the limits to which it is congenitally predetermined."

The investigations by Brodie and others (1938) showed that orthodontic treatment did not change the dental base relationship, but that nearly all the changes were in alveolar bone.

An analysis of treated cases soon confirmed that even if appliances other than those in Brodie's investigations were used, and these included the so-called functional appliances, the conclusions were correct. This finding opened up a whole field of investigation into the question of the aetiology of malocclusion and the factors which permitted satisfactory results to be obtained in some cases but which in others caused relapse.

Careful unprejudiced clinical observation and recording of several thousand cases led to three important conclusions.—

1. That the dental arches, whether normal or abnormal, were in a position that was in balance in soft-tissue morphology and behaviour.

* A Paper read at the Country Meeting of the British Society for the Study of Orthodontics, Sheffield, May 7, 1955.

2. The stability of the end-result depended on the dental arches also being in balance in soft-tissue morphology and behaviour.

3. Soft-tissue morphology and behaviour was not nearly so amenable to change and re-education as had generally been believed. As far as this concerns the linguo-facial balance of the arches, this has been discussed and illustrated elsewhere. (Rix, 1946, 1953; Ballard, 1948, 1951 a, b, 1953, 1955; Gwynne-Evans and Ballard, 1947; Tulley, 1954.)

It might be as well to point out to would-be critics that the conclusions have been arrived at by inductive reasoning after an unprejudiced clinical analysis of many thousands of cases. Theories were abandoned because they were not in accord with clinical findings. It would seem that now is the time to attempt to formulate a new scientific approach based both on experimental biology, conclusions drawn by biologists studying animal behaviour, and on our own clinical observation.

The conclusions set out above led to an investigation into the whole biological background of behaviour in order to support, if possible, the new conclusions and show why the old ones were wrong. It is the purpose of this paper to describe, very briefly, the scope of the experimental work on investigations into the biology of behaviour and then, relating conclusions drawn to clinical observation, to suggest a more biological approach to orofacial soft-tissue behaviour and in particular to the posture and movement of the mandible.

For many years it has been vaguely appreciated that function must play an important part in orthodontics, but its true significance has been overlooked. Gesell (1942, 1945, 1952, 1954) gave orthodontists a clue to the problem which we have been slow to accept. He said: "and just as bone and teeth have characteristic forms, so do patterns of behaviour.

"What is meant by a behaviour pattern? Simply a defined, formed response of the neuromotor system to a specific situation.

"Whether we are concerned with bones or behaviour, the fundamental determiners of form are intrinsic; they are endogenous rather than exogenous. So-called environment does not generate the progressions of development. Environmental factors support, inflect, and specify, but they do not engender, the basic forms and sequence of ontogenesis.

"This principle of maturation certainly applies to the physical morphology of the mouth and to the movements of the mouth."

Behaviour biologically is the total response that an organism makes to any situation with which it is faced. This includes at one extreme the simple reflex activity which physiologists have investigated and, at the other extreme, the highly complex behaviour which psychologists have attempted to analyse. In between these two extremes, however, there are many levels of integration which are important from our point of view because orofacial behaviour is organized at a higher level than the simple reflex, but, except possibly in the case of sucking "habits", not at the level that has concerned psychologists.

Weiss (1941) outlined in 1925 the hierarchical concept of the organization of behaviour by which it is envisaged that there is, in the nervous system, ascending complexities of organization. For example, the stable patterns of motor activity for moving joints is at a comparatively low level. Then at a slightly higher level these are co-ordinated to produce walking and swimming, etc., and these levels of activity are organized at a still higher level to produce the complex behaviour such as feeding, hunting, mating, etc.

Darwin realized the importance of behaviour in its wider sense in natural selection, but the work of Tinbergen (1950, 1951), Lorenz (1950), and others has enabled them to break down behaviour into:—

1. Co-ordinating patterns of motor activity endogenous within the central nervous system.

2. The environmental stimuli which reflexly call forth specific complex patterns of activity which are composed from the endogenous co-ordinating patterns.

In the field of experimental biology, Weiss (1941) demonstrated the principle of myotypic (muscle specific) response which discounts the idea of trial and error learning or that of stereotyped nervous development, producing patterns of motor activity in the individual. He transplanted limb buds, limbs, and single

muscle of amphibia to the opposite side of the body. After the transplanted muscle had received nervous connexions from the segments supplying the limb on the opposite side of the body from their side of origin, it was found to contract synchronously with the muscle of the same name in that limb. In the case of whole limb or limb bud transplants, the muscles when the limb bud had developed, or the limb had received nervous connexions, were found to contract synchronously with the muscles of the normal limb. They performed the same pattern of activity as the normal limb, but, because they were reversed, the activity was opposed to the requirements of the organism.

In the case of a reversal of both fore limbs, the activity of these fore limbs was again a complete reversal of the requirements of the individual.

His experimental work (Weiss, 1950) did not overlook the sensory side, and, in discussing the behaviour of transplanted limbs and muscles, he said: "This very fact that the transplanted muscles contracted in accordance with their names, rather than in accordance with their positions, proves that co-ordination patterns are determined centrally and that the central patterns, though normally reinforced by proprioceptive reflexes, take precedence over the latter under conflicting circumstances. The well-established fact that completely deafferented limbs continue to function without essential impairment of their co-ordination likewise proves that intramember co-ordination cannot possibly be the result of chain reflexes. This in no way detracts from the importance of proprioceptive reflexes as subsidiary reinforcement mechanisms."

On the embryological side, a pioneer in the study of the development of behaviour was Coghill (1914–1936) with the Amblystoma; and Gesell (1942, 1945, 1954) has studied the development of motor activity in the human fœtus and carried these on to post-natal maturation. The general conclusion that can be drawn from this work is that every species of organism has a genetically determined sequence of development both of morphology and motor activity. Gesell (1952) said: "The so-called environment (extrinsic factors) cannot generate the progressions of ontogenesis—the momentous movement from zygote to embryo to fœtus to infant, and the dramatic advance from limb bud to hand to reflex grasp to voluntary prehension, manipulation, and construction.

"These progressions are primarily governed by genes functioning as chemical agents obedient to cues. Maturational mechanisms underlie the marvellous sequence of ontogenesis. Maturation is the net sum of the gene effects operating in a self-limited life cycle."

A review of this subject was made by Davenport Hooker in 1952.

It would appear, then, that patterns of motor activity develop endogenously and that what we have thought to be learning is in fact the result of the processes of maturation of the central nervous system.

To test this theory, Carmichael (1926, 1927) investigated the incipient swimming movements of tadpoles while still in the egg capsule. He kept a group of them under continuous chloretone anæsthesia. When a control group had reached a stage of activity which could be well assessed, those under the chloretone anæsthesia were placed in fresh water and were found to be in exactly the same stage of maturation as those who had apparently been learning the swimming activities.

Similar observations have been made by other workers on other animals.

With regard to behaviour of a more highly complex nature, it is interesting to note that Hess in 1944, by stimulating the diencephalon of intact cats with electrodes, succeeded in producing complex patterns of behaviour such as fighting, hunting, and sleeping.

Finally, in this very brief review of the biological background to oro-facial behaviour, it must be noted that just as morphology has evolved through natural selection, so has behaviour. Both morphology and behaviour are adapted for the survival of the individual in an expected environment and each individual has a limited power to adapt to a new environment.

In Weiss's experiments the amphibia with the transposed limbs showed no power to adapt

their neuromotor system to the new situation, even after as long a period as a year. In mammals, also, there is little evidence of adaptation.

Sperry (1940, 1945) performed tendon and nerve cross-experiments in rats and found that they cannot overcome the resulting disorder. Sperry also reported that with similar experiments on monkeys there was only "a possibility of a very faint trace of adaptation" to the disorganization of function. In man, nerve and tendon crosses are performed to help the individual to overcome a disability, but, here again, the power to adapt is dependent on long training and almost certainly much conscious effort.

The new patterns of activity produced do not replace the endogenous ones but only control them from a higher level. In moments of stress, sleep, etc., endogenous patterns reassert themselves, even after many years.

The author suggests that in applying the present-day concepts on behaviour to that of orofacial behaviour, the following hypotheses can be stated:—

1. The mandible has a postural relationship to the maxilla which is endogenously determined, mature at birth, and probably remains stable throughout life.

2. There is a repertoire of patterns of activity of the muscles of mastication, likewise endogenous, used for mastication, speech, etc.

3. These hypotheses apply to the muscles of the tongue and muscles of facial expression.

4. The position of the dento-alveolar structures developing from the dental bases and their occlusal level is determined by the posture and activity of the orofacial and masticatory muscles.

It is also possible to suggest that any adaptation of behaviour to occlusal variations (environmental factors) or changes of patterns of activity, theoretically required for correction of a malocclusion, must be by one of the following mechanisms:—

1. By conscious control and prolonged practice.

2. By a reflex activity, the physiological mechanism for this being already present in the individual as a result of evolution.

If these hypotheses are correct, it is important for the orthodontist, and in fact the prosthetist or periodontist, to know whether there is any reflex adaptive ability in orofacial activity and, if there is, the extent to which it can be used.

As has been previously mentioned, clinical observations on the behaviour of tongue and muscles of expression in relation to the linguofacial balance of the dental arches and their significance in prognosis and treatment planning have been reported elsewhere by Ballard, Rix, and Tulley.

It is now proposed to relate these hypotheses to clinical observation on the posture and movements of the mandible, firstly in relation to normal development. As has been previously pointed out (Ballard, 1953) the newborn infant, clinically, has a definite posture of the mandible, tongue, palate, and facial soft tissue. This level of maturation has to be reached by birth for the survival of the individual. It maintains a closed oral cavity and clear post-nasal airway. The newborn infant also has the power to respond to at least two environmental situations in specific ways.

At birth, respiration commences reflexly and when food stimulates the dorsum of the tongue, the feeding pattern of activity also commences reflexly. Further than this, Gesell has suggested that the "tonic neck reflex" which develops in utero is important in:—

1. Orientating the fœtus to the birth canal;
2. Posturing the infant at the breast.

Into this already comparatively mature morphology of behaviour, the dento-alveolar structures develop from the dental bases into occlusion.

The dento-alveolar structures grow vertically into a genetically predetermined intermaxillary space until their inherent power of growth is balanced physiologically by masticatory and other mandibular activities. The forces involved must be very light because two teeth in contact are sufficient to maintain a normal interocclusal clearance. A reflex mechanism is almost certainly involved.

The result of the work of Thompson and Brodie (1942) and Thompson (1946, 1949)

on the physiological rest position and the interocclusal clearance, lends support to the view that the postural position of the mandible is endogenous in the individual and that the occlusal level is physiologically established.

The term "physiological rest position" has led to some confusion. Electromyographically there is a minimum of electrical activity in the muscles which maintain the posture when the individual is sitting upright, has a natural position of the head, and is looking straight forward. However, this posture is not maintained as the result of the reciprocal activity of groups of muscles at a physiological resting tonus. Nor is it simply the result of activity of anti-gravity muscles with resting tonus of depressors. If the individual is inverted, the mandible still maintains this postural relationship to maxilla, but quite obviously the pattern of muscle activity has had to be changed. The postural position is a property of the central nervous system. In the majority of individuals, this postural position of the mandible is maintained even during sleep. The term "physiological rest position" is misleading, therefore, and a more correct definition would be the "endogenous postural position".

Many workers in attempting to confirm Thompson's finding of the constant postural position of the mandible, discovered varying degrees of inconstancy. In the author's view this is due to the nature of the experimental methods. As soon as an individual's posture is disturbed, either by having his head clamped in a cephalostat or as the result of a conscious knowledge of what the observer wants, then the endogenous postural pattern of activity may not be produced. Only by careful clinical observation can the true postural position be found in each individual and when found it can then be reproduced for purposes of recording, radiographically or by other means.

Thompson also investigated the path of closure from "physiological rest position" (endogenous postural position) to occlusion. He found that the normal path of closure was a smooth movement into occlusion through a distance which is the interocclusal clearance of about $2\frac{1}{2}$ mm. The direction as represented by the lower incisor was upwards and slightly forward. At occlusion there was a uniform contact of the whole dentition. This activity has been and is being investigated electromyographically, and the general conclusions seem to be that there is a uniform activity of bilateral pairs of muscles although the pattern of activity has individual characteristics. Thompson also found certain types of variations in this path of closure. The abnormalities in the path of closure which he described, and with which we are concerned at the moment, are those in which the mandible, moving through the normal path of closure, makes an occlusal contact which is abnormal in that the inclined planes appear to result in a sliding action with the path of closure thereafter deviating along the inclined planes either distally, laterally, or mesially.

Since Thompson's original work was published, these abnormal paths of closure have been further investigated. An attempt was made last year by Ballard and Grewcock (1954), as the result of this fuller analysis, to explain the physiological background. The important clinical observations reported were that the abnormal contacts were not made during normal masticatory movements, but could only be detected when the individual during the clinical examination was moving slowly from the endogenous postural position into occlusion. It has further been noticed that if the abnormal contact is removed, the individual rapidly reverts to the normal path of closure.

It was suggested that the masticatory movement which avoided the abnormal contact was a habit movement reflexly established as the result of the abnormal contact being made during idle mouth movement. If it was made during normal masticatory movement, it would certainly result in trauma to the supporting structures of the teeth, whereas the teeth that were the subject of these contacts were never clinically loose.

As the result of the work of Pfaffman (1939 a, b), and Stewart (1927), it was suggested that only very light contact was

necessary to initiate the afferent stimuli which produced the habit movement.

The finding of Hopper (1955) that the condyle is not displaced forward in Class III cases which have a postural element can easily be explained on this basis of the physiology of deviation from the normal path of closure.

The aetiology of these cases is that morphologically they are Class III but to a lesser degree, so that when the mandible moves through a normal path of closure, the first contact is an incisor edge-to-edge. This, reflexly and subconsciously, is not tolerated, and the mandible makes an avoiding action which is the apparent forward posturing.

From the generally accepted action of the muscles of mastication it may be suggested that the following is what occurs: at the point at which incisor contact would be made in normal masticatory movement, the posterior parts of the temporalis muscles relax, the lateral pterygoids pull forward the condyle, and the masseter muscles go into isometric contraction to prevent opening. As soon as the incisor contact has been avoided, the temporalis muscles contract again carrying the mandible upwards into an overclosed position.

There is invariably associated with this movement an excessive freeway space or interocclusal clearance.

The author has reported this in greater detail (Ballard, 1955) and, to quote, "the abnormal edge-to-edge incisor contacts made during idle movements of the mandible result in afferent stimuli from the pressure receptors in the periodontal membrane producing a protective habit movement of the mandible, which avoids this contact. This physiological mechanism also accounts for the constant finding of an excessive interocclusal clearance and overclosure in these cases. With a normal path of closure the occlusal level of the cheek teeth would be at about the level of the incisor edge-to-edge contact, but the normal pattern of activity which determines the occlusal level is reflexly disturbed. There is muscle activity to produce the deviation when there should be relaxation.

"Nevakari (personal communication) has found that the mandible in normal path of closure tends to rotate about a site which is downwards and backwards from the condyle. If this is so with the deviation under discussion, then this fact together with the overclosure would account for the finding that the condyles are not forward in the glenoid fossæ in the occlusal position. The rotation of the mandible has carried the condyles back after the forward disengaging movement.

"This, however, is a rather mechanistic explanation and the author would prefer a more physiological approach as follows: if the mandible reflexly moves forward to avoid the incisor contact, not only is there the extra motor activity to produce this movement but the main muscles of mastication are lengthened a fraction.

"It is endogenous within the neuromuscular mechanism to produce an occlusal level slightly closed from the rest position. The closing muscles are contracted and shortened from the rest position. This position can only be achieved after the forward disengaging movements by the mandible continuing to close (to an overclosed position) by rotating round a position downwards and backwards from the condyles. This movement also results in the repositioning of the condyle as previously described."

These findings and the theory as to the physiology of them are in accordance with the hypotheses put forward earlier in the paper. The mandible not only has a posture which is endogenously determined, but there are endogenously produced patterns of muscle co-ordination which result in so-called normal path of closure. Therefore, when the mandible moves in its endogenously determined path of closure into occlusion, it can be postulated that either the position of the cusps of the teeth, determined at least partly by the linguo-facial balance of soft-tissue activity, must result in a cuspal relationship which throws no lateral stresses on the dentition, or if lateral stresses are thrown on the dentition in true centric, then either:—

1. There is a reflex mechanism producing a habit movement—in other words, there is proprioceptive control of the endogenous patterns of activity; or

2. The habit movement is not formed and the teeth which are the subjects of the abnormal contacts will be traumatized.

Schweitzer (1951) has discussed this from the aspect of oral rehabilitation and refers to "centric jaw relation" and centric occlusion. If the latter is not in harmony with the former, then there may be "harmful effects".

The analysis made by Ballard and Grewcock (1954) also led them to suggest that the pain which was so frequently associated with mandibular displacement of the clinical types described, was most probably within the muscles and referred to the joint—the reflex activity, in other words, was disturbing the endogenous patterns of co-ordination, resulting in inco-ordination and strain. This view is supported by the finding that there are frequently tender areas in some of the muscles in such cases.

At this stage it is a good opportunity to refer back to the "physiological rest position", as described by Thompson. There is now no doubt in the author's mind that the distal path of closure which Thompson found in many Class II, Division I occlusal abnormality cases were not true distal displacements reflexly produced by abnormal cuspal contacts. The true explanation of this path of closure is that the mandible is habitually postured forward in order to enable the individual to maintain an anterior-oral seal across an increased overjet (Ballard, 1951a). This forward posturing also occurs in speech and any other activity which necessitates lip contact. Such a position of the mandible should be called a "habitutal postural position", as against the "endogenous postural position".

This is confirmed by the fact that, as has been shown by Ricketts (1952), the condyles are farther back in the glenoid fossæ at the end of treatment—in other words, the reduction of the overjet during treatment no longer necessitates the posturing forward of the mandible to help to bring the lips into apposition. Many individuals establish this habit of posturing forward as the result of conscious effort to close the lips across an increased overjet, particularly when they have an incompetent lip posture. This forward posturing has previously been discussed by the author (Ballard, 1951a).

It is also likely that a full and more careful investigation of our tongue thrusting (abnormal swallowing behaviour) cases will show that they can be divided into at least two types. It has been previously assumed (Ballard, 1953) that because most of the cases exhibiting this behaviour to a severe degree show no change of behaviour after orthodontic treatment and cannot control it by conscious effort, that all such cases are endogenous in origin. More recently, however, a careful analysis of cases out of retention after treatment has shown that some cases in which a tongue-thrusting behaviour was noted at the first diagnosis no longer exhibit the behaviour. From the original diagnosis, they are the types of cases in which the tongue thrust was not severe but as the result of other factors there was an increased overjet frequently associated with incompetent lip posture. It is too early to attempt to report fully on these two types. It is now likely that some of these cases are endogenous; they are those that do not improve as a result of treatment and cannot be improved by conscious effort. Those that do improve may be a habit behaviour, such a habit behaviour being reflexly established, to produce an anterior oral seal in cases of incompetent lip posture associated with an increased overjet, the anterior oral seal being produced by the tip of the tongue thrusting forward against the contracted lower lip, the upper lip being comparatively inactive. It has further been noted that in many of these cases they appear to drop the mandible from the endogenous postural position to enable them to push the tip of the tongue between the teeth against the lower lip. It is this type of case which has no gap between the lower incisor teeth and the upper incisor teeth or palate when the cheek teeth are in occlusion. If the explanation just given of this type of case is sound, then they should not be classified as having an abnormal freeway space or excessive inter-occlusal clearance.

Whilst discussing the endogenous postural position of the mandible, it should be mentioned that so-called "functional appliances"

work because they hold the mandible out of its true postural position. The central nervous system attempts reposturing from this position. This results in a pull on the body of the mandible which, transmitted to the teeth, is to all intents and purposes the same as intermaxillary traction. It is for this reason that Gresham (1952) found that in treated Class II cases the condyle was in its normal position at the end of treatment, although it was forward when the functional appliance was being worn at commencement of treatment.

Likewise, as has been previously mentioned by the author (Ballard, 1953), it is because the endogenous postural position of the mandible cannot be changed that functional appliances do not treat cases in the way that many authors state they do—that is by reposturing the mandible and altering patterns of motor activity.

In the light of this biological approach it is possible to speculate on the relationship between the facet formation in abnormal paths of closure, in cases of traumatic occlusion, and, what is probably a related mechanism, the marked attrition which is found in good occlusions.

It has been previously noted that very light pressure only is required to stimulate reflex avoiding action, but although it was postulated that the reflex activity was produced not by contact during masticatory activity but during idle movements, the author now thinks that it is likely that the facets seen in these cases could not have been produced by these idle movements, unless bruxism was present.

It is more likely that the facets are produced not by the teeth sliding across one another in contact, but by these surfaces of the teeth moving across one another in close proximity with food interposed. If this is so, then the marked attrition which one sees in good occlusions might be the result of the cuspal interdigitation as the occlusion developed, being in accord with the endogenous masticatory patterns of activity of the mandible. This permits full excursion and a maximum of movement of the surfaces of the teeth across one another, with food interposed. This is the evolutionary relationship between form and function as demonstrated by Mills in Primates (1955), which is no longer an important survival factor with present-day diets.

From our reasoning, we must accept the fact that any cuspal formation and occlusal relationship that is not in accord with the masticatory patterns of activity, will reflexly control the use of the endogenous movements. This is obviously what happens in extreme Class II, Division 2 cases, where no lateral excursion is possible, because of the excessive incisor and canine overbite; therefore, no attrition is found.

There is only one other habit activity which should be mentioned in connexion with abnormal cuspal relationship and that is bruxism. A theory for the establishment of this as a habit has already been put forward by the author (Ballard and Grewcock, 1954). It was suggested that it might be a reflexly established habit produced by cusps which interfered with the endogenous patterns of masticatory activity in an attempt to wear them away.

Finally, it can be pointed out that all the observations on the behaviour of the lips and tongue and clinical experience with their behaviour in relation to orthodontics, prosthetics, and periodontics which have been reported elsewhere by the author and others, such as Rix (1946, 1953), Tulley (1952, 1953, 1954), Hovell (1950, 1955), and Gwynne-Evans and Ballard (1947) support the hypotheses that have been put forward in this paper. To summarize, there is no evidence that the variation in tongue posture and behaviour can be re-educated. Any changes in behaviour that occur might easily be due to the fact that the behaviour noted before treatment was a reflexly established one, as for instance the lip tongue contact associated with a forward posturing of the mandible to produce an anterior-oral seal, when there is an increased overjet and incompetence of lip posture. Clincial observation indicates that incompetent lip posture cannot be changed, but that an individual may either reflexly maintain an anterior-oral seal by contraction of the orbicularis and metalis muscles, or in the

extreme cases, by conscious effort, teach himself to maintain an anterior-oral seal.

As has been previously stated, many of the cases with a vigorous tongue-thrusting behaviour also have an interdental sigmatism. This interdental sigmatism may either disappear from speech as the individual grows up or can be eliminated under the instructions of a speech therapist, but its elimination from the speech is not associated with any change in tongue behaviour which can be noted clinically, and the interesting thing is that the sigmatism returns when the individual is under stress or excited. This is similar to the experience with the training after nerve and tendon crosses.

SUMMARY

It is pointed out that previous theories and concepts on neuromotor behaviour (function) of the orofacial soft tissues have not been sound in relation to clinical experience.

The research work that has been done on the evolution, embryology, and development of behaviour is briefly reviewed. The general conclusions that can be drawn are that in the animal the basic patterns of motor co-ordination are endogenous in origin, determined as are other morphological characters by evolution. These basic patterns of co-ordination arise within the central nervous system and are not the result of reflexly stimulated trial-and-error learning; they cannot be eliminated, but can be modified reflexly to form habit patterns which are not permanently learned but have to be continually reinforced.

It has been shown how these principles can be applied to orofacial behaviour. They explain many of the recent clinical observations that have been briefly reviewed and offer a new approach to function in relation to orthodontic, prosthetic, and periodontal problems.

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DISCUSSION

Mr. Kettle made the observation that it was his belief that the occlusal arrangement of the teeth followed in the wake of functional movement and did not dictate it.

Mr. Elgey asked to what extent myofunctional appliances permanently changed the temporomandibular joint.

Mr. Hovell asked whether Mr. Ballard considered that the atypical swallowing patterns were truly endogenous and therefore probably hereditary or were they abnormal behaviour patterns acquired in utero at an early stage of development and therefore perhaps not endogenous but environmental prenatally.

Mr. Tulley said that he wished to take Mr. Ballard up on a number of points he had made. He entirely agreed with the basic concept that Mr. Ballard had put forward, but he did not believe that man could be compared with any other animal. The taking over of control by higher centres and the acquisition of habit movements was the very thing that made man different from animals. He said that it had been shown clearly by Weiss that after a tendon transplant in man, re-education by exercise could occur to enable normal function to take place. A dentist, after a few years of chairside work, tends to develop a poor posture generally and it is exceedingly difficult for him to revert to normal bodily posture even if it is endogenous. He thought it was wrong to dogmatize to the extent that Mr. Ballard had in this paper.

Mr. Jason Wood asked how much are we to try to persuade patients to overcome these endogenous ill-conceived postures? He thought he had been able to change patterns of behaviour in some of his patients, but perhaps his observations had not been sufficiently acute.

He would like to make a point by quoting a famous local duck. Normally a duck has two legs but this one was born with four, all of which it tried to use. It found walking very difficult until it had learnt to use two legs only and tuck the other two up under its wings.

Mr. Readings asked Mr. Ballard if he had any observations to make on the apparent overclosure in cases of partial anodontia.

Mr. Mills asked Mr. Ballard about the type of case of the fairly normal occlusion with the upper lateral incisors palatally placed and just inside the bite. The patient could just bite edge to edge on the upper lateral incisors. When these are pushed over the bite there is a definite overjet. He did not believe that these cases were overclosed. How did Mr. Ballard explain this type of case?

Mr. Walpole Day said that there was one aspect of postural Class III cases that had not been touched on. His own daughter had Class III tendencies towards the end of the deciduous dentition, and had enlarged tonsils and adenoids. Following the removal of tonsils and adenoids the upper lingual incisors had erupted to the lowers but without treatment had corrected themselves. He thought that the tonsils and adenoids were factors to be considered.

Mr. Ballard, in replying to Mr. Kettle, said he had raised an important issue and it was difficult to make an unprejudiced judgement as to which came first, the hen or the egg. To his mind, the biological background indicates that the patterns of activity came first and that either the cusps fit in with those patterns of activity or else the subsidiary proprioceptive mechanism described by Weiss control these patterns to avoid trauma in most cases. One cause of periodontal problems is that in some cases this mechanism does not protect the supporting structures of the teeth.

In reply to Mr. Elgey, he thought it possible that the position and the very shape of the condyles were determined by the endogenous patterns of activity. He thought it likely that the condyles were adapted to each individual's movement.

Mr. Hovell had raised a very important point indeed. He thought it was impossible in the time available for him to deal with the possibilities of environmental influence in utero. It might be that the basic co-ordinating patterns of activity of the tongue are "imprinted" on the central nervous system at some brief and definite stage of maturation in utero by the sensory contact

between say the tip of the tongue and the mucous membrane of the premaxilla. Any variation from the normal at this stage might "imprint" patterns of activity which we would call abnormal in the post-natal individual.

In reply to Mr. Tulley, in discussing the question of the learning of behaviour patterns man appears to learn to walk but what in fact happens is that as a process of maturation more complicated patterns of activity are built up in the central nervous system on the basis of the endogenous co-ordinating patterns. In training for special activity man may by conscious control modify the endogenous co-ordinating patterns of activity but these modifications were never permanently imprinted on the central nervous system.

With reference to tendon crosses he had made the point himself that man could overcome the disorganization, but only by conscious control after prolonged training, but the habit movement did not displace the endogenous co-ordinating patterns which would appear at any time that conscious control was lost. He had said that the monkey had not this conscious control.

He thought Mr. Jason Wood was probably not distinguishing between endogenous postures and patterns of activity and the reflexly established or habit ones. Probably all the changes in posture and behaviour associated with orthodontic treatment were either the elimination of reflexly established habits or the establishment of a habit to overcome an endogenous posture, or behaviour which was æsthetically or functionally unsatisfactory. The incompetent lip posture was a good example of an æsthetically and functionally unsatisfactory posture. After orthodontic treatment many individuals maintained for most of the time a lips-closed habitual posture by conscious effort. It did not matter for how long this was maintained, the muscles always had to contract from the endogenous posture of the open or incompetent position to produce a lip seal.

In reply to Mr. Readings he made the point that Mr. Hopper had already made, that it was the overclosure in these cases which gave the appearance of the mandible coming forward.

He thought that in the case that Mr. Mills had described the reflex posture to avoid those inlocked lateral incisors was so slight as not to fundamentally alter the endogenous pattern, therefore, there was no overclosure. With regard to Mr. Walpole Day's daughter, he thought that the best answer to this was that he had many Class III cases which had been put on the waiting list to push the incisors over the bite and after waiting some three or four months he had found that the incisors had come over the bite themselves. He thought that enlarged tonsils played no part at all in the production of these adverse incisor relationships.

A.R.P.A. INTERNATIONALE

THE fourteenth Congress of A.R.P.A. Internationale (Association for Research into Periodontal Diseases) was held in Venice, Sept. 6–11, 1955, under the presidency of Professor A.-J. Held.

Five themes were discussed, these being "bruxism"; "modifications in the height of the bite as a means in gnatho-functional therapy"; "selective grinding"; "gingival curettage and epithelial reattachment"; and "epidemiology of periodontal diseases". Dr. W. G. Cross (Institute of Dental Surgery, University of London), who attended as representative of both the Fédération Dentaire Internationale and the British Society of Periodontology, was one of the co-reporters on "epithelial reattachment and gingival curettage". He also presented a most interesting paper on "the replacement of resorbed alveolar bone by bone-grafts" and a colour film on "chrome-cobalt implants". Other British contributors were Dr. E. C. Fox, who reported on "oral and gingival manifestations of epidermolyois bullosa hereditaria in brother and sister" and "silver tattooing of gingivæ"; and Mr. A. Bryan Wade, who presented a paper on "selective grinding" in which he discussed the problems involved in teaching this form of therapy to undergraduate students.

This Congress was notable for the fact that it was the first time that representatives of the United States of America A.R.P.A. (Californian Academy of Periodontology) had been present. Professor Hermann Becks, Drs. A. W. Ward, R. Thomas Dunkin, Samuel Bleadon, and Barney Rosasco of the Academy all made prominent contributions in the form of papers, films, or table demonstrations. Present also were Professor Samuel Charles Miller, of the New York College of Dentistry, Dr. Perry A. Ratcliff, Editor of the *Journal of the Western Academy of Periodontology* from California, and Dr. Warren Toff, of Boston, at present at the Institute of Dental Medicine, University of Geneva, all of whom read papers.

Most of the recognized authorities on periodontology in Western Europe were present and many had interesting papers to read. As always, however, the great benefit to be derived from such a congress was in the personal contacts to be made and the innumerable private discussions which took place.

A full social programme was most enjoyable and all who were present must already be looking forward to the fifteenth Congress, which will be held in Paris in 1958.

A CONTRIBUTION TO THE FUNCTIONAL ANATOMY OF THE MANDIBULAR JOINT*

By RUDOLPH SPRINZ, B.D.S., F.D.S. R.C.S.

THE literature on this joint is so profuse that to approach the subject with originality is nearly impossible. This is the only joint with which the dental practitioner comes in contact, and sight is often lost of the fact that there are joints similar to it in the human body. Histologically the sternoclavicular joint re-resembles the temporomandibular joint (*Figs.* 1, 2).

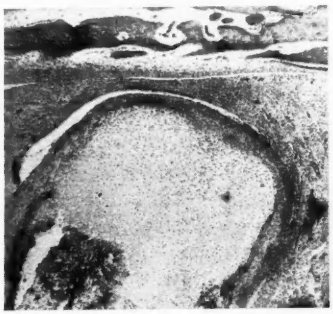

Fig. 1.—Temporomandibular joint. Fœtal, 110 mm. (× 21.)

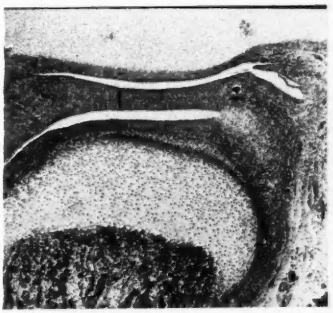

Fig. 2.—Sternoclavicular joint. Fœtal, 110 mm. (× 21.)

Fig. 3.—Head of clavicle, cartilage canal. Fœtal, 110 mm. (× 21.)

Histology.—The term "cartilage" is used to describe a connective tissue made up of a cellular element and a matrix containing few blood-vessels. The cells are arranged in a regular pattern, usually in columns. The matrix is a homogeneous, faintly granular structure which is interlaced by a fine network of collagen fibres. The matrix is impregnated with a chondromucoid material which gives cartilage its marked basophilic staining reaction.

This explanation is necessary in order to simplify the terminology of various structures in this joint which are often mistakenly referred to as "cartilage", as the naked-eye appearance suggests a gristle-like structure. Dense fibrous tissue can give this appearance as well as cartilage.

The mandibular joint is made up of the bony component of the condyle of the mandible inferiorly, the glenoid fossa and eminentia articularis of the temporal bone superiorly. Separating the condyle from the temporal bone is an intra-articular disk.

Up to the age of about 25 years the condyle of the mandible presents on its superior surface the remnants of the cartilage from which the bony condyle was formed. This cartilage is more cellular than hyaline, and contains but little intercellular matrix. This structure is described as "secondary cartilage". It is the only true cartilage tissue found in the human temporomandibular articulation, and draped

* A Paper read at the Country Meeting of the British Society for the Study of Orthodontics, May 7, 1955.

over it on its superior aspect is a firm fibrous membrane, the articular membrane.

The secondary cartilage is one of the growth centres of the jaw. Dipping into it at intervals are deep gutters spoken of as "cartilage canals". The canals (they have been demonstrated by Haines, 1933, and Hurrel, 1934, in epiphyses of long bones) penetrate from the

Fig. 4.—Side of skull showing normal condyle position.

articular membrane through the whole depth of the cartilage to the point where ossification is taking place. They consist of a fine interlacing fibrous tissue and contain the blood-vessels supplying the cartilage (*Fig.* 3).

Sicher (1952) stresses the difference between this secondary cartilage and the epiphyses of long bones. The main difference is that the epiphysis of a long bone, as well as the head of the clavicle, presents a secondary centre of ossification. In the mandibular condyle the conversion of cartilage into bone is a continuous process and no separate centres are demonstrable. The situation, appearance, and function of the secondary cartilage are, however, noticeably similar to those of an epiphysis.

The cellularity of the cartilage may account for the abnormal behaviour of this growth centre during a disease affecting hyaline cartilage tissues—namely, achondroplasia. In this disease all cartilage structures and bones formed from cartilage are underdeveloped. Yet the mandible is quite normal and appears too large for the underdeveloped base of skull. This disharmony leads to an apparent Angle Class III in patients suffering from this disease (Stones, 1948).

The condyle, whether in the young or old, is covered by the articular membrane (also sometimes spoken of as cartilage), which is a dense fibrous tissue. The synovial space containing the lubrication fluid for the inferior compartment of the joint separates the articular membrane from the intra-articular disk, which consists of firm fibrous tissue but which is again sometimes spoken of as cartilage. A detailed study undertaken of the disk in mammalia—it is absent even in some mammals—shows that cartilage tissue and cells are rarely found here. So far only in one species, the panda (*Ailurus fulgens*), were any cartilage cells or any matrix observed.

The temporal surface of the articulation is separated from the disk by the upper compartment, again containing synovial fluid. This surface, like the condyle, is draped over by an articular fibrous membrane.

Stability.—The fact that the mandibular joint is a very stable one is accepted by most observers, though which of the following factors represents the most stabilizing is still in dispute: (*a*) the congruity of the bony surfaces; (*b*) the capsule and ligaments; (*c*) the muscular balance.

a. Congruity of Bony Components.—Although the convexity of the mandibular condyle appears to conform fairly accurately with the concavity of the glenoid fossa, actually it does not rest in the fossa, not even in the most retrusive position of the jaw (*Fig.* 4). The condyle is applied to the posterior slope of the eminentia articularis and the intra-articular disk is interposed between the head of the condyle and the upper articulating surface. Nature is capable of providing close-fitting joints, e.g., the mandibular joint in the badger (*Meles meles*). In this animal the zygomatic process almost envelops the mandibular condyle, so that disarticulation of the lower jaw is impossible without fracture of bone. On the other hand the knee-joint in man is quite stable despite no close fit between femoral condyles and tibial plateau. It

appears, therefore, that the bony components in the mandibular joint, as in the knee, may not form the essential element in the stability of the joint.

b. Capsule and Ligaments.—The capsule surrounding this joint in man is only well defined laterally, where it is re-inforced by the temporomandibular ligament. Anteriorly, posteriorly, as well as medially, it is constructed of fibrous tissue which contains many histological spaces. None the less the capsule plays some role in keeping the bony surfaces approximated, though an important function is to prevent the escape of synovial fluid.

Three ligaments are described with this joint: (1) the temporomandibular; (2) the sphenomandibular; (3) the stylomandibular ligament. Of these, the temporomandibular ligament is of some importance in preventing the dislocation posteriorly of the condyle, as this ligament, of firm fibrous structure, is attached to the tubercle of the zygoma above and to the posterior aspect of the neck of the condyle below. The sphenomandibular ligament plays a small part in stabilizing the joint, being a weak structure bridging the gap between the spine of the sphenoid and the lingula on the medial aspect of the ramus of the mandible. It is the remnant of the fibrous covering of Meckel's cartilage (the perichondrium). During the normal range of movement the distance between the lingula and the spine of the sphenoid does not alter. The movement of the jaw at the lingula is comparable to a pendulum swing whose fixed point is at the spine of the sphenoid. The stylomandibular ligament is also spoken of as a ligament associated with this joint. This ligament does not deserve the name. It is part of the deep cervical fascia which stretches from the lateral aspect of the styloid process to the angle of the jaw. Weak as these three ligaments are, it must be noted that they all exist in pairs, as two mandibular joints tie one mandible to the skull.

c. Muscle Balance.—Muscle balance is the most important factor in maintaining the functional stability of the joint. This subject has been studied by Brodie (1950) and by Last (1954). Recently electromyographic records of the muscles of the jaw have been taken by Tulley (1953), MacDougall and Andrew (1953), and others.

The concepts of Last appear to be the most accurate. He suggests that the mandible is movable on the skull in all positions of the latter and that the balance of the jaw is dependent upon the contraction of one set of muscle-fibres with the relaxation of the opposing muscles. The electromyographic slides of Tulley (1953) and of Greenfield (1955) may give an accurate idea of the components of the muscles which contract during any set movement of the jaw.

The problem of the opening of the mouth is one that has interested me for some time. Many factors, including gravity, the action of the mylohyoid and lateral pterygoid, the anterior belly of digastric, and the geniohyoid muscles have been held responsible for this movement. Last (1954) suggested that the opening of the mouth is primarily effected by the action of both parts of the digastric muscle (anterior and posterior belly) together with the lateral pterygoids. The digastric in a number of animals is a single belly muscle stretching from behind the ear to near the angle of the jaw. This muscle is known as the occipito-mandibulare and can only fulfil one function, the opening of the mouth. In most animals the occipito-mandibulare has a dual nerve-supply, from the trigeminal as well as the facial; often a slight fibrous intersection can be seen dividing that part of the muscle supplied by the former from that supplied by the latter (*Fig.* 5). The fibrous intersection is widened in primates, where the muscle has taken on a two-belly appearance (digastric). The widened intersection has become a tendon which is quite loosely bound down to the hyoid bone by means of a sling (*Fig.* 6). Contraction of the anterior belly alone would pull the relaxed posterior belly through the sling. Contraction of the posterior belly would pull the anterior belly through the sling. Contraction of both when the hyoid bone is fixed will, however, pull the chin downwards and backwards. The hyoid bone remains on the same horizontal level during opening, though it moves slightly anteriorly.

The opening mechanism is assisted by the lateral pterygoid and geniohyoid muscles, though the effect of gravity on the opening cannot be of significance.

The Intra-articular Disk.—Parsons (1900) studied this structure and wondered why the disk was missing in some animals. This fact, indeed, makes the appreciation of the reason for its existence in others very difficult. The Tasmanian devil (*Sacrophilus ursinus*) and the *Dasyurus* probably have a better functional dentition than the dog in that their premolar teeth articulate. Yet neither *Sacrophilus* nor *Dasyurus* has a disk. The badger has an upper articular surface so closely fitting around the condyle that there would appear to be little or no room for the disk. Yet this animal has a complete disk.

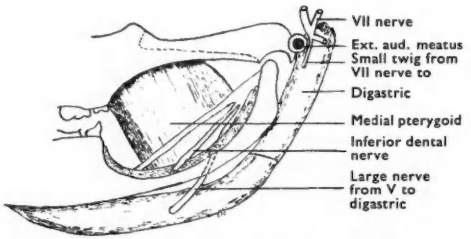

Fig. 5.—Diagram of occipito-mandibulare in the panda.

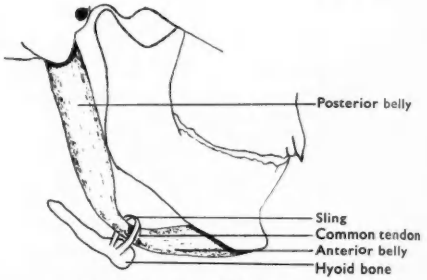

Fig. 6.—Diagram of digastric muscle.

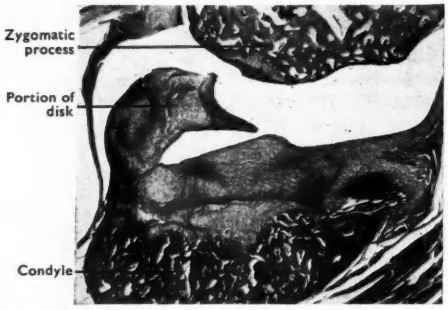

Fig. 7.—Mandibular joint of rabbit 16 weeks after partial meniscectomy. (× 15.)

The embryology of the mandibular joint has been studied by Harpman and Woollard (1938) and more recently by Symons (1952). These authors suggest that the disk is a condensed portion of the lateral pterygoid muscle, possibly its tendon. Yet in those marsupials where the disk is absent a muscle is found which is homologous with the lateral pterygoid. As Parsons has already pointed out, intra-articular disks are absent not only in some marsupials but also in some eutherian mammals, e.g., the Indian pangolin (*Manis*) and the armadillo (*Dasypus*) belonging to the order of Edentata.

Whatever its origin, in man the disk has an attachment in addition to that to the lateral pterygoid. Anterolaterally it is attached to the masseter muscle. This attachment was first brought to my notice by the late Leonard Rees (1954). The masseter, on contraction, would pull the disk laterally. The lateral pterygoid would pull it medially.

So far no satisfactory reason for the presence of the disk has been found. It may serve to reduce the incongruity between bony surfaces, and yet this appears unnecessary in the joint of the badger.

It may assist a joint which has to perform both hinge and gliding movements, and yet these movements occur in animals without disks, e.g., Tasmanian devil and Dasyurus.

MacConaill (1946) suggested that it acts as a lubrication flange; this may be true, though lubrication in joints lacking disks appears adequate.

It may act as a shock absorber, yet it is absent in joints subjected to stress, e.g., the ankle-joint in man. The weight-bearing parts of the knee-joint are not covered by the semilunar cartilages. It is, however, of

interest to note that in those animals where the disk is absent in the mandibular joint, the upper articular membrane is significantly thickened.

Experimental Work.—In order to gain a more accurate picture of the various components of the mandibular joint, they have been excised surgically in rabbits (Sprinz, 1954). The disk was removed in both young and adult animals and at no time was any vestige of disk re-formed (even when a part of the disk was left in situ) (*Fig.* 7). This feature is quite unlike the results of meniscectomies of the knee-joint as described by Walmesley and Bruce (1938) for the same animal. These authors showed that the semilunar cartilages had re-formed within twenty-two days after excision (but the re-formed tissue was not quite as firm as the original). From these studies it would appear that intra-articular disks may serve different functions in different joints.

The experimental work on the excision of the articular surfaces is being continued and the initial results indicate that condylar and zygomatic surfaces regenerate after bilateral excision. (Condylar regeneration in 30-day-old rats has been demonstrated by Jarabak, 1953.) The levels of the regenerated surfaces are approximately the same as the pre-operative levels, an observation which suggests that little or no pressure develops in this joint in rabbits.

A case of a woman aged 55 who died following an accident is described by Boman (1950). This patient had both mandibular disks excised nine months previously. The post-mortem examination did not reveal any signs of regeneration. This finding is contrary to the view expressed by Robinson (1946) and Hankey (1954), who suggest that the disk is capable of repair though offer no evidence for this suggestion.

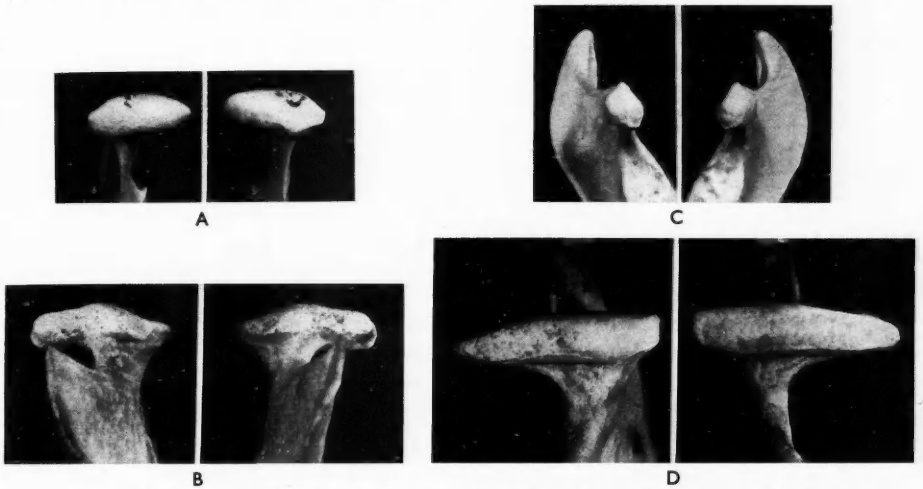

Fig. 8.—A, Human condyles; B, Condyles of dog; C, Condyles of cavy; D, Condyles of polar bear.

Statements that the condyle regenerates in man have been made to me by a number of surgeons, though as the operation of condylectomy would have followed disease of the tissue, no precise conclusion can be drawn from such cases as can be drawn from the results on experimental animals.

General Observations.—

1. *Individual Variations in Outline of Joint Components.*—Following a survey of the mandibular condyles of material available at the Charles Clifford Dental Hospital at Sheffield the following observations were made:—

A. *Human*: Mandibular condyles showed a marked asymmetry which became more marked with increasing age (*Fig.* 8 A).

B. *Comparative*: Mandibular condyles of domestic animals, such as the pig and the dog (*Fig.* 8 B), showed more asymmetry; wild animals such as the cavy (*Fig.* 8 C) and the polar bear (*Fig.* 8 D) showed hardly any asymmetry.

Fig. 9.—Radiograph of normal joint space.

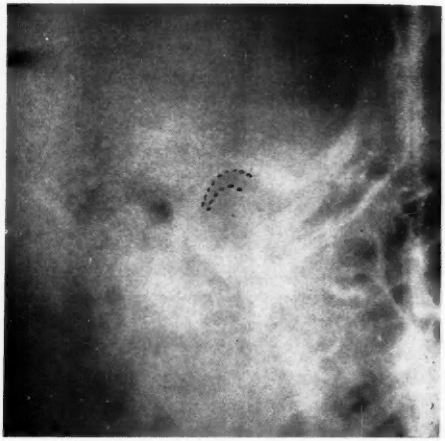

Fig. 10.—Radiograph of "reduced" joint space.

2. *Relation of Asymmetry to X-ray Appearance.*—The asymmetry mentioned above in relation to mandibular condyles may lead to misinterpretation of "joint space", a term given to the radiolucent area around the condyle as seen in a radiograph. A further complication of this problem of assessing the joint space is the fact that a reduced joint space can easily be produced by a slight tilting of the X-ray tube (*Figs.* 9, 10). Laminography would appear to be the best answer to this difficult problem of assessing the joint space.

My experimental work on the mandibular joint in rabbits suggests that even a considerable amount of surgical trauma causes few functional disturbances. Many mandibular teeth have been extracted in patients, with considerable trauma to the joint, but rarely does a joint give rise to clinical symptoms after such treatment. These observations lead me to suggest that the mandibular joint has a fairly wide safety margin and one which is not often exceeded.

SUMMARY

1. The histological appearance of the mandibular joint is described.

2. The stability of the joint is discussed, and muscular balance is considered to be the main factor responsible for stability.

3. The mechanism of opening of the mouth is described, with special reference to the role of the digastric muscle.

4. The function of the intra-articular disk is discussed, with reference to comparative anatomy and experimental surgery.

5. Asymmetry of mandibular condyles is described, and reference is made to the difficulty of assessing the correct joint space by radiography.

I wish to express my thanks to Professor Francis Davies for his valuable criticism. I would also like to thank Mr. I. F. Coombe and Mr. R. Cousins for preparing the diagrams and illustrations for this paper.

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DISCUSSION

Mr. Tulley, opening the discussion, said how pleased he was to hear a clear lecture on the basic anatomy of the temporomandibular joint. He said he thought that Mr. Sprinz would be the first to agree that, although our knowledge is improving on this joint, we are still far from fully understanding it. The electromyograph technique of studying the muscular activity has its drawbacks. He said that the histological approach on experimental animals was a very important aspect of the subject.

He thought that Mr. Sprinz's statement that the sternoclavicular joint was the same as the temporomandibular joint was open to some misinterpretation as it had no functional similarity. He entirely agreed with Mr. Sprinz about the importance of the muscle balance. He stressed the importance of studying the joint and the dentition as a functional unit.

He was not aware that it was possible for regeneration of the intra-articular disk in the knee-joint and he felt that it was not likely that such a regeneration would occur in the temporomandibular joint. He was very interested to hear that it was possible to get regeneration of the condyle in rabbits. With regard to the mechanism operating in the condylar cartilage he was not sure if he agreed with Mr. Sprinz and quoted from Sicher's work where he described appositional as well as interstitial growth of cartilage which distinguishes it from a normal epiphysial cartilage not covered by a fibrous cap.

Lastly, he entirely agreed with Mr. Sprinz that although the joint was subject to considerable abuse, cases presenting symptoms were surprisingly small.

He thanked Mr. Sprinz for a most interesting and stimulating paper.

Mr. J. Campbell mentioned all the problems of laminography and pointed out the snags in getting really precise standardized pictures of the temporomandibular joint. He said that no doubt laminography was more precise than the original oblique methods of X-raying the joint, but he pointed out, however, that the patient's head could not be completely stabilized by putting plugs in the cartilaginous portion of the external auditory meatus. He then commented on the regeneration of the condyle in rabbits. He said that he had evidence of regeneration in man. He referred to a case which he had shown to the Society in October, 1954, which was printed in the *Dental Practitioner* (February, 1955) of a woman with acute rheumatoid arthritis involving one temporomandibular joint. The condylar head had eroded into a stump with a sharp spike. Plans were made to resect the remains of the condyle, but her condition improved and muscle spasms disappeared and serial laminographs showed a regeneration of the condyle or at least a rounding off or formation of a better articular surface.

Mr. Campbell thanked Mr. Sprinz for opening up a channel of animal experiments on the joint, which he thought were most valuable.

Mr. J. Beresford said that in the human joint, if you suspect that there is something wrong with the disk you can hear a definite click and can feel the roughness of the movement by palpation. Could Mr. Sprinz say whether he had observed any clicking or roughness in rabbits where he had removed the disk?

Mr. G. Taylor questioned the musculature in the mechanism of mouth opening. He reported a patient who had no digastric muscle as it had been destroyed by radium treatment and who was quite able to open his mouth freely. He thought that more conclusive evidence of the role of the digastric muscle in mouth opening should be produced by electromyograph recordings.

Mr. Sprinz, in reply to the discussion, said that he was well aware of the gaps in our knowledge concerning the temporomandibular joint which was one of the reasons why he was doing his present research and he thought that in twenty years' time he might be in a better position to explain some of the present unknown factors. He said that there was nothing he could add to Mr. Campbell's exposition on the X-ray side of the problem. He said that it was important to bear in mind the differences in the shape of the joint on each side. He agreed with Mr. Tulley that the dentition must be studied in conjunction with the joint. He said that he was grateful to Mr. Tulley for making the point concerning the difference between the mandibular growth centre and the epiphysial cartilage.

In connexion with the sternoclavicular joint, he had only likened it to the temporomandibular joint in its histological structure and not from the functional viewpoint. In connexion with the regeneration of the disk, he had been very careful to keep off the clinical aspect. He quoted from an article by Boman in which postmortem investigations failed to show any regeneration of the disk following its removal nine months previously. With regard to the regeneration of the cartilage in the knee-joint, which he had discussed with Mr. Tulley, there were several authorities who had produced evidence to show that this did occur. He would add, however, that by regeneration (both in man and animals) he did not mean the structure returned to its original form quickly.

In reply to Mr. Beresford, he had never heard a clicking in the temporomandibular joint of rabbits.

In reply to Mr. Taylor he said that he did not consider that one should quote gross pathology to support theories on normal function. It was well known that muscles can undertake trick movements, and in such a case as Mr. Taylor had quoted other muscles would take over the role of those which had been lost.

BONE-GRAFTS IN PERIODONTAL DISEASE*

A PRELIMINARY REPORT

By **W. G. CROSS**, M.S., M.B., B.D.S.

A PRESIDENTIAL address to a learned Society—and in this, our seventh year, I think the claim is a fair one—a presidential address is an opportunity which, coming as it does but rarely to any one individual, must be valued by him who delivers it for two principal reasons: the first being that it enables him to express his deepest appreciation to his fellows for electing him to their Society's highest office; and the second, the opportunity to deliver a homily, expound a doctrine, flagellate those who provide forms for completion, reminisce, anticipate—the while with a comfortable inner glow owing to the fact that he cannot be assailed with questions afterwards, and that common courtesy will in all probability assure him of a modicum of applause, however abysmal his oratory. I am deeply conscious of the honour you have done me in electing me your President, and can only say that I will do my best while in office.

I propose to-day to follow the example of some of my predecessors in office, and tell you, at not too great length, of the work being done in my Department at the Institute of Dental Surgery to deal with one of the more serious problems that the periodontist encounters—the management of the case in which alveolar supporting bone has been lost.

It is, I think, fair to say that chronic periodontitis is, in the main, reasonably susceptible to adequate treatment by present-day methods, consisting, as you know, of the removal of all local tissue irritants, elimination of pockets, and the re-establishment of a sound functional occlusion. This latter may be a simple process, involving a limited amount of selective grinding alone, or it may necessitate the extraction, or, where practicable, orthodontic repositioning, of badly misplaced teeth, alteration of the occlusal relationships by prostheses or restorations, and the splinting of individual teeth or groups of teeth. This local therapy may be assisted, in a rather small proportion of cases, by the correction of a dietary or endocrine deficiency.

Bone-grafting is not new, and has been practised in many parts of the body for a great number of years, but due, I think, to the peculiar topographical features of the alveolus, and the difficulty of avoiding infection, it has not, as far as I am aware from a far from complete survey of the literature, been carried out in order to replace alveolus lost as a result of periodontal diseases. It should, however, be pointed out that Beube (1953) has advocated the use of boiled bone powder over a period of some twenty years.

It has been long appreciated that under favourable circumstances a measure of bone regeneration can occur, and many individuals have demonstrated the reformation of interdental bone to a more coronal level, often with reformation of a lamina dura radiographically. This may occur after curettage, gingivectomy, or splinting, or a combination of these.

This bone regeneration is commonly seen following the successful treatment of the periodontal abscess, but it is also met following curettage of the intrabony pocket, especially the narrow-mouthed variety.

Where the pocket is wide-mouthed, the chance of bone regeneration occurring is slender and is, of course, decreased by any undue mobility of the tooth. I believe, in fact, that no substantial regeneration of bone will take place if the bony orifice of the intrabony pocket exceeds 3 mm.—and that occurs in many cases.

Four years ago I turned my attention to the possibility of utilizing bone-grafts for the second type of case, and commencing in March, 1952, I carried out three separate

* The Presidential Address given at the opening of the seventh annual session of the British Society of Periodontology, at the Eastman Dental Clinic, Oct. 3, 1955.

grafts. These were all for patients with intrabony pockets involving anterior teeth and were autogenous grafts—i.e., obtained from a donor site such as an edentulous area in the same patient. By means of a small trephine, a window of cortex was removed and a small quantity of spongiosa then curetted out. In two cases out of three the donor areas were rather painful post-operatively, so that I was relieved to hear of the establishment of a bone bank by the Orthopædic Department of the Royal Free Hospital. All subsequent cases—about ten in all—have received homogeneous grafts from this bone bank, and I would like to express here my gratitude to Mr. Gray and his registrars for the facilities I have had and the excellent co-operation they have provided.

In order for a graft to succeed, it would seem that the following are essential:—

1. A clean, non-inflamed operative field.

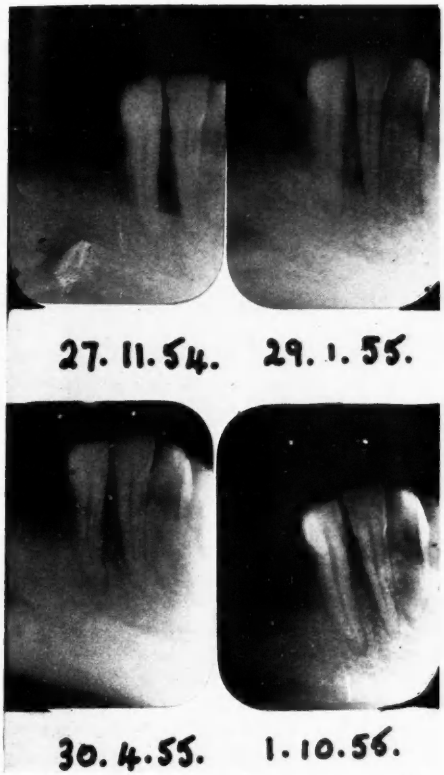

Fig. 1.—Deep spiral intrabony pockets on mesial and lingual aspects of $\overline{3}$. Graft inserted December, 1954. No clinical pockets at present date.

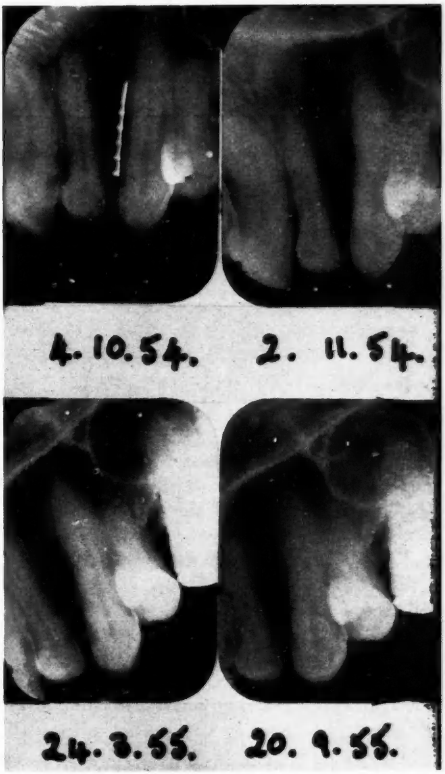

Fig. 2.—12-mm. mesial intrabony pocket $\underline{3}$, about 6–7 mm. intrabony. Graft inserted November, 1954. No clinical pocket at present, only 2 mm. crevice. Note altered contour of tooth due to curettage.

2. Minimal mobility of the teeth concerned.
3. Avoidance of post-operative infection.

With these in mind, therefore, the following technique has been employed: As a preliminary procedure, the pocket or pockets are thoroughly curetted in order to remove all deposits on the root surface, granulations and pocket epithelium. If the tooth is mobile, it must be splinted effectively by any of the usual

methods and the occlusion corrected at the same time. The graft proper may take place two weeks later, providing that there is no clinical evidence of inflammation or suppuration.

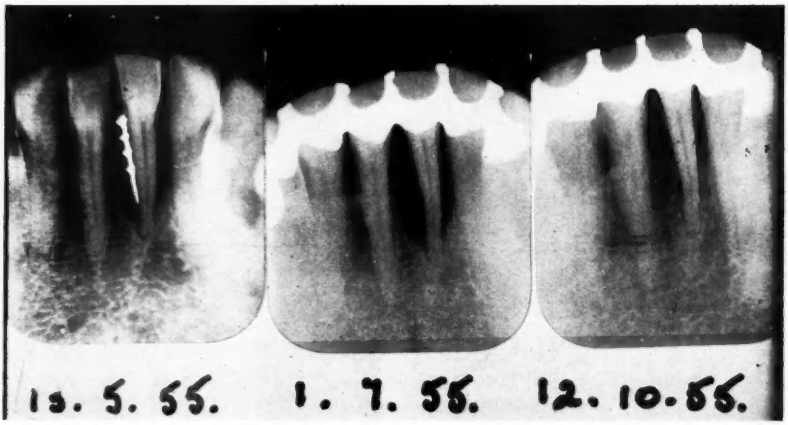

Fig. 3.—10-mm. intrabony pocket $\overline{1}$, about 5 mm. intrabony. Graft inserted June, 1955, after immobilization of $\overline{1}$ by removable splint. 4-mm. pocket at present date.

The operation is carried out under local analgesia and penicillin cover—300,000 units of procaine penicillin is administered intramuscularly.

Whether a flap is raised, or whether the graft can be inserted without, will depend on the accessibility of the deepest recesses of the pocket. The whole area is re-curetted, using sharp hoes or curettes to remove all cementum and curettes to remove any pocket epithelium which has reformed. The area is now ready for the positioning of the graft.

Two days before operation a suitable portion of bone is selected from the bone bank. The bone bank is, in effect, a deep-freeze unit, and the stored bone, which has been removed at operation, is first cultured and then placed in a sterile glass jar. This is then left in the deep-freeze unit until required, when it is removed, and left for 24 hours in a penicillin-streptomycin solution. Prior to this the bone has, of course, to be thawed out.

The bone to be grafted is then placed on a sterile towel and small fragments of spongiosa are dissected away from it, and placed on one side. The fragments require to be small and several in number; this is considered preferable to using one larger portion, since if any superficial infection supervenes, or if the area has been over-packed—a danger which must be guarded against—bone will exfoliate, and with luck this may occur to the topmost fragment only.

The fragments are now gently placed into the intrabony pocket and built up until the desired bone height is achieved. It must be borne in mind, however, that the blood-clot which forms as a result of the curettage will shrink somewhat, and in doing so the topmost fragment may become exposed—therefore underpack rather than overpack.

All that remains is to place a suitable protective dressing over the area. Tin foil is adapted so as to cover the gum margin, part of the crown, and the interdental papilla, yet leaving a space above the foil into which a standard gingivectomy pack can be placed. The purpose of the tin foil is to provide a non-irritant wound protection and the purpose of the gingivectomy pack is to maintain the tin foil in position.

The patient is given a note for the physician requesting daily administration of intramuscular procaine-penicillin for a further three days, and the pack is removed at the end of a week.

After this, the patient may brush the area cautiously with a soft brush, and after a fortnight commence the careful use of interdental stimulators. No exploration of the former pocket should be attempted for at least a month.

I would like to make it clear that this work is at an early stage and that over-optimistic conclusions cannot be drawn from a few cases over too short a period of time. Thirteen cases have been treated so far, five of these by my registrar, Mr. McClure. Some measure of success is apparent at this stage and *Figs.* 1–3 show the radiographical changes in three of these cases. It is my hope that I shall be able to show you further radiographs five years from now with the clinical and radiographical appearances maintained. In conclusion, I wish to thank the Photographic Department of the Institute of Dental Surgery for the preparation of the lantern slides, and you, ladies and gentlemen, for your kind attention.

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BRITISH SOCIETY OF PERIODONTOLOGY
Annual General Meeting

THE ANNUAL GENERAL MEETING was held on Monday, October 3, at which the Council for the 1955–56 session was elected. The Council will be:—

President: W. G. Cross, M.S., M.B., B.D.S.; *President-Elect*: Professor M. A. Rushton; *Retiring President*: F. E. Hopper, B.D.S., F.D.S. R.C.S.; *Hon. Secretary*: A. Bryan Wade, B.Ch.D., F.D.S. R.C.S.; *Hon. Editor*: E. D. Farmer, M.A., M.D.S., F.D.S. R.C.S.; *Hon. Treasurer*: G. A. Cuthbertson, H.D.D. R.C.S., L.D.S., R.F.P.S.; *Hon. Librarian*: E. C. Fox, D.M.D., L.D.S. R.C.S.; *Full Members*: R. D. Emslie, M.S., B.D.S., F.D.S. R.C.S.; R. J. G. Grewcock, L.D.S. R.C.S.; *Associate Member*: H. Colin Davis, L.D.S. R.C.S.

COLLEGE OF TECHNOLOGY, BIRMINGHAM
Department of Metallurgy

The distribution of prizes and certificates to successful students of the courses in Dental Technology will be held in the main hall at the College of Technology, Suffolk Street, Birmingham 1, on Friday, December 9, at 7 p.m., and will be followed by a lecture. The meeting will be open to all members of the Dental Profession and their friends.

A. J. Walpole Day, B.D.S., H.D.D., L.D.S. R.C.S., will distribute the awards and afterwards deliver the lecture entitled "Orthodontics To-day". A selection of students' work will be displayed.

The Relief of Pain associated with Lesions of the Mucous Membrane

The pain associated with inflammation and ulceration of the mucous membrane varies in intensity from a mild discomfort to an intolerable, continuous pain. The control of local pain usually is accomplished with topical anæsthetics applied or sprayed to the areas of ulceration. One of them which has proved most efficacious is xylocaine viscous 2 per cent. It has a low surface tension and high viscosity and therefore it spreads evenly on the mucous membrane and sticks to the surface for a considerable period of time, which allows the anæsthetic to be absorbed locally before it is washed away. It has been successfully used in the following conditions: Reducing the gingival pain associated with deep scaling; aphthous ulcer; denture irritation; severe ulcerative stomatitis; contact dermatitis with painful bullous and ulcerated areas on lips and tongue; post-operative condition following treatment of cancer of the soft palate; cancer of œsophagus; ulcers of mucous membrane of unknown cause, probably neurotrophic.

It is important to remember that topical application to the unbroken surface of mucous membrane prior to insertion of a needle does not produce any significant anæsthesia.

When used in small doses, no toxic symptoms could be observed and repeated doses did not seem to reduce its effectiveness. It is only poisonous in large doses approximating 4 oz. a day.—SANDLER, H. C. (1955), *Oral Surg.*, **8**, No. 3, 260.

AN INLAY-WAX AND SQUASH-BITE ANNEALER

By **S. D. HATT**, B.D.S., and **F. F. LYON**
Dundee Dental School, University of St. Andrews

No inlay or other indirect restoration can be more accurate in fit, or precise in detail, than the wax pattern from which it originates. Any imperfection of the pattern will produce a badly-fitting restoration with a broad cement-line. The life of the restoration is, in most cases, governed by the thickness of the cement lute, which should be of minimal dimension.

There is little doubt that many discrepancies in the fit of an inlay are due to incorrect manipulation of inlay wax, particularly the method by which the wax is softened.

Manipulation of Wax.—Wax is mainly amorphous in structure, that is, its molecules are not disposed in an ordered or geometric pattern, as are those of the metals. Waxes are known as "supercooled liquids". Yet, if wax is moulded at too low a temperature strains will be set up between the molecules. Wax molecules appear to arrange themselves at more or less equally-spaced distances from each other. Should these distances be altered, forces trying to separate or approximate the molecules are set up.

Even at room temperature any forces or internal "strains" present are relieved by a slow change in the shape of the wax, as its molecules settle into more comfortable, unstrained positions. Therefore if a strained wax pattern is not cast immediately, it will change its shape. At the temperatures used for investing inlays (usually mouth temperature), these strains are more readily released. It is obviously essential therefore that as little strain as possible be present within the wax pattern.

As far as the degree of strain is concerned, the shape of wax should only be altered while the molecules have completely free movement —that is, while the wax is molten. This is not practicable, particularly when making direct inlay patterns in the upper jaw. In addition, the thermal contraction of wax on cooling gives rise to an inaccurate pattern.

Inlay wax, or indeed any wax, should be softened sufficiently to enable the molecules to assume a relatively unstrained relationship within the new shape, and the entire mass of wax should be in this soft condition.

Softening a stick of inlay wax over a bunsen flame does not produce an evenly softened mass, as wax is a poor conductor of heat. The inner layers of the wax are always harder than the outside, unless softening is carried out for some 4–5 minutes. Only the warm air above the bunsen flame should be used for softening and no fusion of the wax surface should take place. If the flame itself is used, volatilization of some of the lower-fusing constituents of the wax will take place, and this will reduce its plasticity and flow. Consequently, the detail of the pattern will not be so accurate and the wax will be more brittle and difficult to trim and carve. Warm water may be used for softening, when a more evenly heated mass of wax will be produced. But again, some of the lower fusing constituents may leach out into the water. Water may also become incorporated within the wax, causing "flaking" or "layering" of the pattern during trimming.

The ideal method of wax softening, or "annealing", therefore, is to use a thermostatically controlled dry oven. Electric furnaces for this purpose have been made, but are expensive to buy and their internal temperature is not easily controlled within the small range which separates soft and molten wax.

Inlay Wax Annealer.—The temperature of a water-jacketed container is easier to control. An "annealer" is shown in the accompanying illustration. This model was constructed in clear acrylic sheet for demonstration purposes (*Figs.* 1, 2).

It consists essentially of a small box fitted with a lid which contains the wax, and which is surrounded by a water-jacket. The water is heated by a 50-watt element designed for heating tropical fish-tanks, and its temperature is controlled by a thermostat made for the same purpose. Both these units are contained

in "Pyres" test-tubes which project into the water. Usually the points of the thermostat require bending a little farther apart so that the temperature necessary for softening the wax can be attained. The temperature of the water is adjusted so that the surface of the wax does not become glazed. Temperatures of 48–56° C. are used, depending upon the particular inlay wax in use. These temperatures are somewhat high, but it will be appreciated that some heat-loss to the atmosphere takes place and that the temperature of the wax is lower than this. A similar type of annealer for laboratory use may be constructed using an ordinary electric light bulb as a heating element, as described by one of us (Lyon, 1955). This form of annealer is more bulky, but is easier to construct.

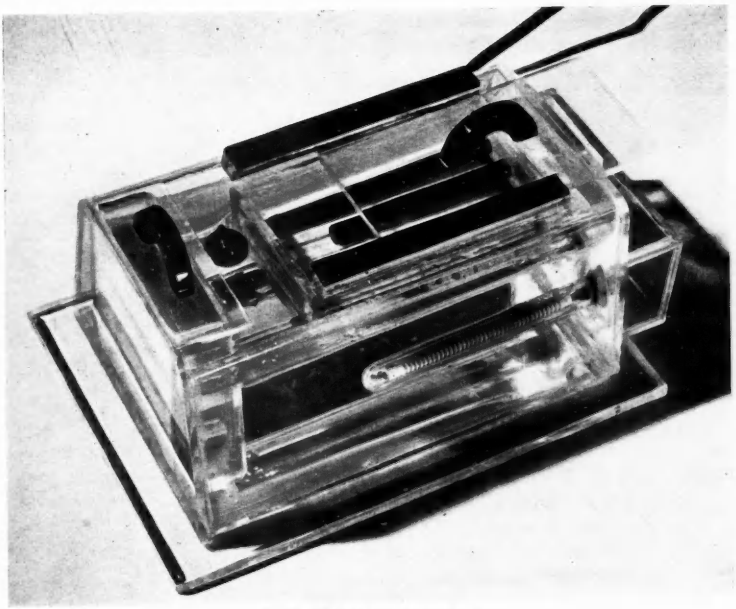

Fig. 1.—Inlay wax annealer.

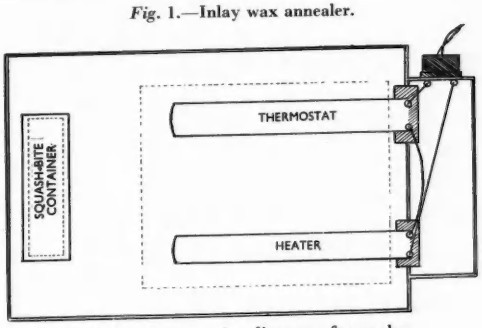

Fig. 2.—Construction diagram of annealer.

Wax Squash-bite.—When carrying out the chairside work necessary for the construction of an indirect inlay, there is a tendency to concentrate on the impression, and to place

less emphasis upon the accuracy of the squash-bite. This frequently leads to a faulty occlusal height and poor contact points of the casting. Correction of these faults expends valuable surgery time.

In securing an accurate squash-bite, several difficulties arise. Many patients find difficulty

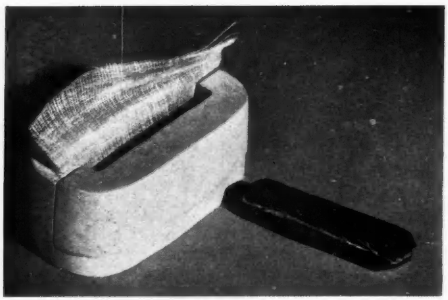

Fig. 3.—Forming wax bites in plaster mould.

in closing directly into centric relationship, especially when a tough, foreign body such as a normal squash-bite, is placed to one side of the arch. When force is required to squash the wax, a chewing motion is used, and the resulting impression is poorly defined. A wax squash-bite of soft "buttery" consistency will offer little resistance to pressure and will adapt itself perfectly to the teeth.

In the thermostatically-controlled annealer, a separate, slightly cooler compartment is shown, which contains wax squash-bites suitable for recording the occlusion for indirect inlays. Usually, a squash-bite is made at the chairside from sheet denture wax. Such a squash-bite is not very accurate as the wax tends to separate into layers, and also, being unevenly softened, does not achieve a good impression of the teeth. The wax squash-bites used in this annealer are poured from molten scrap wax, and have a layer of dental napkin in their centre to impart strength. They are made by pouring wax into a wet plaster mould as shown in *Fig.* 3.

The resulting squash-bite gives an accurate impression of the teeth and the inlay cavity and ensures a centric relation which is separated only by a few napkin fibres. The thin dental napkin strengthens the bite at its weakest part, thus reducing the possibility of breakage in cases where the occlusion is almost complete (*Fig.* 4).

With this type of squash-bite, dies may be positioned in the wax impression with a high degree of accuracy. There is usually no need to fasten the die to the wax while the model is

Fig. 4.—Wax bite-block after removal from the mouth, showing dental napkin strengthening thin areas.

being cast. To prevent warpage of the bite it is suggested that the model of the opposing teeth is poured first, before the die is positioned. Then the model is completed by pouring the remainder of the impression.

Our thanks are due to Mr. J. N. Anderson for his assistance in designing the apparatus; and to Mr. J. Grierson for the photographs.

REFERENCE

LYON, F. F. (1955), *Dent. Technic.*, **9**, 8.

Premedication for Difficult Children

The barbiturates are considered to be suitable premedicants for the apprehensive, the difficult to manage, and the handicapped child and infant. The author concludes that they are of considerable value when used intelligently and cites several cases where seconal or nembutal has been combined with Demeral to give satisfactory results.—ALBUM, M. M. (1955), *J. dent. Child.*, **22**, No. 1, 48.

A BITE-BLOCK RIM TRIMMER

By JOHN N. ANDERSON, B.D.S. (Sheff.)
Queen's College, Dundee, University of St. Andrews

In some techniques of bite recording the rim of both bite-blocks must be trimmed to a flat surface. The upper block is carved so that its rim is at the incisal level, and the plane of its surface is made parallel with the interpupillary and ala-tragus lines, or other similar anatomical planes. Then the lower bite-block is trimmed to the correct vertical dimension and its surface is shaped to make full and even contact with the upper bite-rim. By producing two flat contacting surfaces, errors of centric relation are reduced, as then there are no surface irregularities of the wax rim which, by premature contact, may guide the mandible of the patient into an eccentric position.

At the chairside it is not easy to trim a bite-rim to a flat surface, and, in addition, the wax shavings produced litter the surgery bench-space.

Several methods of shaping the bite-rim have previously been suggested in which the excess wax is melted away by applying the rim to a heated metal surface. A plasterer's trowel or other flat sheet of metal heated by a bunsen is already used by some practitioners. In both these methods molten wax drips from the hot metal surface onto the bench, and difficulties arise in supporting the heated trowel away from the bench surface when it is not in use. In addition, heating of the metal plate by a bunsen is not easy to control. These previous methods, therefore, are not ideal for use in the surgery of a private practitioner.

A simple bite-rim trimmer has been designed which overcomes these difficulties (*Fig.* 1).

Construction.—The trimmer consists essentially of a metal box (a "Zelex" tin), lying on its side. The upper surface is cut away at an angle and is replaced by a sheet of 18-gauge brass sheet, which is soldered in position. The original lid of the tin is then adapted to carry a *metal* lamp-holder. A hole of suitable diameter is cut in the centre of the lid, and a small extension tube is soldered into this. The metal lamp-holder must be a tight fit into this extension tube. If the lamp-holder is placed directly through the metal lid, using a normal locking ring, a larger tin will be required to accommodate an electric light bulb of normal length. It is advisable to keep the trimmer as small as possible for surgery use; and for this reason an extension tube is preferred. Two small ventilation slits are punched in this end of the tin to prevent any possible overheating.

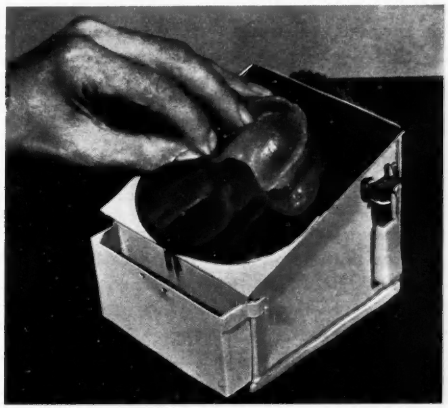

Fig. 1.—Trimming the rim of an upper bite-block.

A 60-watt bulb is placed in the holder, and this heats the brass plate to 70–80° C. A wax bite-rim held against this surface is rapidly reduced in height. Changes in the plane of the rim are also easily effected by altering the angle at which the bite-rim is placed on the "hot-plate". As the wax melts, it runs down the sloping metal surface and is guided to the centre of its bottom edge by two lengths of wire in a U-shape. These wires are soldered in position and at the lowest point of the U they project downwards over the edge of the brass plate. At this point the molten wax drips down into a small detachable metal box. It will be noticed that the wire is not present on the right-hand side of the hot-plate. This gap

is left to enable a lower bite-block with prominent "retromolar" (or "pear-shaped") pads to be trimmed. Such a bite-block is held so that its "heels" project over the sides of the hot-plate.

Use.—The trimmer should be switched on five minutes before it is required for use so that the hot-plate attains the correct working temperature.

To trim a bite-rim, mark the correct level on the wax and apply the rim to the hot-plate so that the open end of the bite-rim points downwards. Then the molten wax will flow freely away. The wax in the container remains molten, and may be emptied by means of the small handle shown in the photograph. In eight months' use in the Prosthetic Department of this Hospital the bite-rim trimmer has reduced the length of time required to record a bite. By reducing the difficulties of wax trimming more attention can be focused on the important clinical factors of bite recording.

Acknowledgements.—I am indebted to Mr. F. F. Lyon, Senior Instructor in Dental Mechanics, who constructed the trimmer; and to Mr. J. Grierson for the photograph.

A One-piece Fixed Bridge

A method is described in which Duralay, a self-polymerizing acrylic resin, is used to replace impression material and casting wax in the reproduction of the abutments. Copper band impressions of the preparations are plated and cast, and copings made on the resulting positives with the Duralay. With these copings seated in the mouth, an impression is made and cast in stone, the metal models of the abutments being located in the copings held in the impression. Acrylic veneers are suitably trimmed, and, while these are held in position by means of a plaster overcast, the pontic is waxed up for casting, the copings being incorporated in the wax-up. The veneers having been removed, the wax is undercut for acrylic retention and investment applied to the exposed surfaces. This having hardened, the whole is removed from the model and the investment completed, the copings forming a part of the final wax-up.—BRUNO, S. A. (1955), *J. pros. Dent.*, **5**, 401.

Investments for Dentists

The authors suggest that a thousand dentists are making poor investments for one who is making good investments. The purpose of the article is to bring some system out of the chaos of dentists' investing. The field of investments open to dentists are divided into thirteen main types, of which the first is the office equipment. The instalment plan method of purchasing dental office equipment should never be used because it is a wedge leading to an unsatisfactory investment policy. He who insists on a straight business loan is establishing himself as a business man, not as just another dentist sucker. The automobile more than than any other one thing is the cause of the failure of dentists to be able to retire. Because it is going to be bought any way it is discussed as investment number three. The value of your home should be figured at two and one half times the net income for one year. Regarding Government bonds, you will get the number of dollars you put in even if they will not buy so much. In the stock market the important thing is the safety of principle and continuance of income, and not what the general public and your wife think of your stocks. Having established the authors' programme you may be ready for investment number thirteen, which is the second automobile. It is pointed out that they are made in Detroit faster than you can ever buy them.—HUNT, VERNON L., and HUNT, V. EVERETT (1955), *Amer. J. Orthodont.*, **41**, 291.

CORRIGENDA

In the article in the October issue on "Modern Methods in Periodontal Treatment" by Max Walter, D.M.D., *Figs.* 4–7 and *Figs.* 11–13 should have been inverted, and the legend to *Fig.* 12 should have read $\overline{7}|$ instead of $|\underline{7}$.

LETTERS TO THE EDITOR

Sept. 17, 1955.

Dear Sir,

Recently I extracted seven lower anterior teeth for a patient of mine using xylotox with adrenaline solution by submucous infiltration. The teeth were fairly loose and the extractions were quite easy and perfectly satisfactory. The next day the patient who is an elderly lady of about 71 years of age, returned with a rash on the chin. I attribute this to allergic reaction. After three days the rash disappeared completely.

I should be interested to know whether any other cases of this type of reaction have been reported.

Yours faithfully,
A. I. CASSIM ALLY.

267 *High Street*,
Sutton,
Surrey.

Oct. 14, 1955.

Dear Sir.

In reply to Professor Aitchison's letter in the September issue of the DENTAL PRACTITIONER regarding the appointment of Consultant Orthodontists by Regional Hospital Boards, I have now made further enquiries on this matter and find that as Professor Aitchison says there were several appointments by Scottish Regional Hospital Boards which predated the appointment at Bournemouth. I, therefore, wish to withdraw my statement and take this opportunity of apologizing to the Consultants concerned.

I would like to add, however, that my error was due to the fact that I was unaware that in Scotland the Teaching Hospitals are not grouped separately as in England and Wales and that Teaching Hospital appointments in Scotland are, therefore, Regional Board appointments. I was using the term "Regional Board" as meaning an appointment to a non-teaching Hospital, which is correct for England and Wales but not for Scotland. To be entirely correct my statement should have read ". . . This was the first whole-time appointment in the grade of Consultant Orthodontist by any Regional Hospital Board in England and Wales".

Finally, may I say that the meaning I intended to convey was that it was an encouraging thing for Orthodontics that such appointments were being made. I had no intention of claiming any special merit either personal, regional or national by reason of the appointment.

Yours faithfully,
J. D. HOOPER,
Consultant Orthodontist.

Royal Victoria Hospital,
Boscombe,
Bournemouth.

Sept. 13, 1955.

Dear Sir,

I wonder if you would be so kind as to convey my compliments and thanks to Mr. A. R. F. Thompson for his splendid contribution to the symposium on Occlusal Equilibration which appeared in the May, 1955, issue of THE DENTAL PRACTITIONER.

I sometimes feel that I fight a rather lonely battle against witchcraft in dentistry, and therefore I am greatly heartened by Mr. Thompson's sound common sense and by his courage in expressing it under what must have been difficult circumstances. Since much that he has said would not be popularly received, he may welcome the knowledge that his article has excited the admiration of at least one reader.

His opening paragraphs set the tone for the devastation that follows with inexorable logic. I not only agree with what he has said, but I found delightful his direct and clear way of saying it. While we have thinkers and writers of this calibre, there is still hope for dentistry as a profession and an intellectual discipline as well as a craft.

Yours sincerely,
F. W. CRADDOCK.

Dental School,
University of Otago.

NATIONAL HEALTH SERVICE NOTES

Minister's Address to Executive Councils' Association

THE Minister of Health, Mr. Iain Macleod, speaking on Oct. 21 to delegates to the eighth Annual Conference of the Executive Councils' Association at Brighton, dealt with the progress which had been made in improving co-operation between the various bodies administering the Health Service and the various individuals working in it. There had been many gaps in this co-operation. There still were, but he took heart from a remarkable improvement which in the last year had grown into "something active and imaginative which is of the utmost value". Much remained to be done. We had not arrived at a final solution but he felt that now, if we looked to the bright side of the picture we could see something to which we should all be striving.

Work in the Dental Field: Speaking of the prevention of dental disease, Mr. Macleod said that pilot schemes to demonstrate the beneficial effects of fluoridation of water supplies in the prevention of caries, particularly among children, were being arranged in two centres in England, one in Wales and one in Scotland with the full support of the British Dental Association and the Royal College of Surgeons.

He had recently issued a circular to local health authorities to help them to give a much bigger place to dental health education in the health education carried out by health visitors and other officers.

Turning to the Dentists Bill now before Parliament, the Minister said that one of its main purposes was to recognize "the full maturity of the dental profession by granting it the privilege of self-government". Another purpose was to place the dental profession in the position of making use, subject to suitable safeguards, of ancillary help.

In conclusion, the Minister said that the Health Service was becoming increasingly part of the fabric of our national life, with the pleasant familiarity of everyday things.

Remuneration of Hospital Dental Staff Salary Scale for General Dental Surgeons

MEMORANDUM H.M. (55) 96 amends as from July 1, 1955, the salary scale for whole-time general dental surgeons laid down in memorandum R.H.B. (52) 75, H.M.C. (52) 68, B.G. (52) 72.

1. After considering a claim by the British Dental Association for an increase in the rate of remuneration of whole-time hospital general dental surgeons, the Minister has approved a scale of £1000 × £50—£1700 to operate from July 1, 1955.

2. When appointing a practitioner with more than two years' experience in practice since registration, one of which should preferably have been gained in the hospital service, Boards and Committees may, at their discretion, grant an increment for each additional year of experience up to a maximum of three.

3. Assimilation to the new scale, of present holders of these posts, should in all cases be made on the basis of corresponding points.

4. No officer is to suffer a reduction in salary as from July 1, 1955, as a result of the coming into operation of this new scale.

National Insurance Advisory Committee

The Minister of Pensions and National Insurance has appointed Sir Richard Snedden, C.B.E., to be a member of the National Insurance Advisory Committee in place of Sir John S. Boyd, LL.B. Professor J. K. Charlesworth, Ph.D., D.Sc., Sir Alfred Roberts, C.B.E., J.P., and Mr. H. W. Townley, O.B.E., have been reappointed to the Committee for a further term.

Sir Richard Snedden is the General Manager of the Shipping Federation and Chairman of Industrial Relations and International Committees of the British Employers Confederation. He is also a member of the National Advisory Committee on the Employment of Older Men and Women.